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CALLOPHRYS (LYCAENIDAE) FROM THE PACIFIC NORTHWEST

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OVER TWO YEARS AGO Mr. E. J. Newcomer, of Yakima, Washington, sent for examination and identification a series of *Callophrys* (*Callophrys*) taken near his home. He subsequently augmented this lot by other specimens, some of which were also taken locally while others were from farther afield in the state. More recently Mr. David L. Bauer, of Bijou, California, has sent for study additional specimens of this subgenus from both Washington and Oregon. The present paper is concerned chiefly with this assembled material. My best thanks are due both these gentlemen for the opportunity to study and report on this now sizable and instructive collection from a region whence before *Callophrys* had been all but unknown.

Callophrys is in several ways a very difficult subgenus. Problems of discriminating species occur in several regions, notably (but by no means exclusively) that under discussion in this paper. An even greater problem exists in the group as a whole: the correct association in polytypic species of the various named entities. Six species are currently recognized (Clench, 1961) in the subgenus (*dumetorum* Boisduval, *comstocki* Henne, *apama* Edwards, *affinis* Edwards, *viridis* Edwards and *sheridanii* Edwards), a number which is probably too large. On the other hand, we know that there must be at least two species for two occur sympatrically in many places: *sheridanii* and *apama* in Colorado; *sheridanii* and *affinis* in the Yellowstone area and near Brewster, Washington, *sheridanii* and *dumetorum* near Yakima, Washington; *viridis* and *dumetorum* in the San Francisco Bay area. But throughout their known ranges *apama* and *affinis* do not; nor do *affinis* and *dumetorum; apama* and *dumetorum; sheridanii* and *viridis;* or *affinis* and *viridis.*

It is tempting, and it may possibly be correct, to associate *sheridanii* and *viridis* as one species; *dumetorum, comstocki* (which is sympatric with no other), *apama* and *affinis* as another. This arrangement would satisfy nicely the conditions of sympatry, but it creates other problems; and besides, it is sheer speculation.

The traditional method of resolving such difficulties is by study of the male genitalia. Barnes and Benjamin (1923), the first authors to revise the group, did not make use of these structures nor did I in my revision of some years ago (Clench, 1944). The present occasion seemed an excellent opportunity to fill this long-standing desideratum. Preparations were accordingly made of all of the major and most of the minor entities, usually of several individuals each, and these preparations subjected to study. Preliminary examination failed to disclose any qualitative differences but did reveal the existence of considerable variation in relative lengths of different structures. A series of measurements was then made and these carefully and elaborately analyzed individually, paired in correlations, as ratios and by other more esoteric means, which it is pointless to describe as the results of the whole inquiry were thoroughly, discouragingly negative: the male genitalia of *Callophrys* s.s. show considerable individual variability but give no evidence whatever of variation useful for discriminating species. We are still where we were before.

Three species of *Callophrys* s.s. are now known from the Pacific Northwest, one here recorded for the first time. They epitomize the difficulties noted just above and it would be fatuous to presume that the results here given represent the final word on the solution of those difficulties. Decisions on relationships had to be made and I have tried to make them as accurately as possible.

Callophrys (*Callophrys*) *affinis washingtonia* Clench

Known from Alta Lake (type locality) and Brewster, Washington and from Summerland, Osoyoos, Penticton and Keremeos, British Columbia, the latter records in the Canadian National collection.

Size rather large (about as in *dumetorum perplexa* or *apama*); ground color above greyish with a distinct brownish tinge and in the female with some discal fulvous (occasionally in the male as well); underside apple green, a little less yellowish than in nominate *affinis* but decidely yellower than other members of the genus; on the fore-wing the green extends posteriorly to about CU_2, thus covering most of the wing; postmedian spot row completely absent or at most represented by faint, hardly visible traces. Base of fore wing costa below pale grey.

Callophrys (*Callophrys*) *dumetorum* Boisduval

When Mr. Newcomer sent his first series of *Callophrys* he wrote that he was interested to learn whether they represented one species or two, for some were immaculate below like *affinis,* others well marked, more or less as in *sheridanii.* Study showed that all of this variability actually was comprised in the one new subspecies of *sheridanii* described below. There was a surprise for us both, however, that came to light only when the specimens were being studied after spreading: a single fresh male of *dumetorum* from Satus Creek, 2000 ft., Yakima Co., Washington, taken in 16 May 1960. When I wrote to him about this discovery and described its differentiating characters, Mr. Newcomer checked through his material and found an additional specimen from the same locality taken 16 May 1959. Returning to the same area in the spring of 1961 he was able to take several additional specimens most of which he sent on for study: Kussdhi Creek, off Satus Creek, 2000 ft., Yakima Co., 24 May 1961 (1 female), and 2 June 1961 (1 male); Ski area near Satus Pass, 3700 ft., Klickitat Co., 2 June 1961 (1 female). In the material sent by Mr. Bauer were two males of this species from Shelton, Mason Co., Washington, 2 May 1958. All these specimens represent a considerable northward extension of the known range of *dumetorum* (cf. Clench, 1961: 210).

Three regional lists relating to the area under consideration in this paper have had to be ignored: Bowman (1919) on Alberta; Blackmore (1927) on British Columbia; and Leighton (1946) on Washington state. Each lists *dumetorum* and no other *Callophrys* s. s. (except Leighton, who also lists *dumetorum perplexa* and *sheridanii*), misdeterminations (partial or complete) rather typical of the trouble these butterflies have given to systematists.

Males [Description refers only to Washington material.] are uniform grey above with a very slight brownish cast. Females above are largely dark fulvous, shading to brownish fuscous in the basal third of both wings, along costa, termen and (more broadly) apex of fore wing as well as very narrowly along termen of hind wing. The fringe is greyish white (markedly duller than the fringe of either *affinis* or *dumetorum*), darker basad. On the under surface of both sexes the inner marginal grey of fore wing extends costad usually to M_3; the postmedian line of this wing is tolerably well developed from Cu_2 to M_1 or R_4, but often rather faint, occasionally even obsolete (though a trace of the dark basal part of the line usually persists). The postmedian line of the hind wing is highly variable in its expression, ranging from nearly complete (bars in all interspaces from Sc to inner margin) to nearly absent (slight whitish bars in Sc - Rs and Cu_1 - Cu_2); base of fore wing costa below usually fulvous. Size rather small: about the same as *s. sheridanii.*

The subspecies of *dumetorum* have never been worked out adequately. Even the range of the species is imperfectly known. For the present these Washington specimens seem best left under nominate *dumetorum* with which they agree far more closely than with *d. perplexa* Barnes and Benjamin from the lowlands of southern California.

Callophrys (*Callophrys*) *sheridanii neoperplexa* Barnes and Benjamin

The upper surfaces of both sexes are uniform grey with no tinge of brownish or fulvous. Base of fore wing costa below pale grey. Under surface green, on fore wing extending posteriorly to Cu_2; postmedian lines well developed on both wings, usually more or less continuous (the component white bars conjoined), but rather thin and lacking the black basal edging characteristic of *s. sheridanii.* Size small.

In the Pacific Northwest known only from Brewester, Washington where the late J. C. Hopfinger used to take it rather frequently. Until the receipt of Mr. Newcomer's material it was not realized just how unusual this record is. See the discussion below.

Callophrys (*Callophrys*) *sheridanii newcomeri* new subspecies

The upper surfaces of both sexes are uniform grey, unrelieved by any brownish tint or fulvous, much as in the other *sheridanii* subspecies. Base of fore wing costa below, pale grey. It differs chiefly in the strong tendency to reduction of the postmedian line of the underside, continuing the trend away from *s. sheridanii* that is evident in *s. neoperplexa* Barnes and Benjamin. This is especially marked on the fore wing where most specimens show either no trace of the line at all or only a few faint bars; occasionally it may be fully present but is then only faintly developed. In only one specimen, a female from Ft. Simcoe, is it fully present and strongly developed. The row on the hind wing is rarely completely absent (a female from Mill Creek), but almost always lacks several bars at least, especially those in Rs - M_1 and M_3 - Cu_1. On the fore wing upper side of the Mill Creek series there is a definite, though faint, pale grey patch, strong at cell-end and fading rapidly distad.

Holotype, male, and 5 male *paratypes,* all Mill Creek, 1800 ft., Yakima Co., Washington, 29 March 1961 (E. J. Newcomer) the holotype including male genitalia slide C-791; 5 male and 7 female *paratypes,* Ft. Simcoe, 1200 ft., Yakima Co., Washington, 6 April 1960 (E. J. Newcomer).

Holotype and most of the paratypes, C. M. Ent. type series no. 478. Some paratypes are being returned to Mr Newcomer.

Remarks. In addition to the type series, the following material has been seen: Mt. Spokane, 5000 ft., Spokane Co., Washington, 27 June 1960 (E. J. Newcomer), 3 males and 2 females; Blue Mts., 4800 ft., Columbia Co., Washington, 17 June 1961 (E. J. Newcomer), 2 males; Lonerock, Gilliam Co., Oregon, 7 June 1961 (D. L. Bauer), 2 males and 2 females (doubtfully typical).

The Canadian National Collection has specimens from Waterton Lakes Park, Alberta, and from Okanagan Landing and Vernon, British Columbia, all of which I believe are referable to *newcomeri,* though I saw them but briefly while on a visit in 1956 and made only a few notes on their peculiarities.

The Oregon population and the four from Washington all show a certain amount of independent differentiation. The greatest departure is found in the Lonerock series where females show a definite fulvous tinge above, unique in the species, and the under surface (which is more uniform in appearance than in any of the Washington populations) has the postmedian line on both wings practically obsolete save for the portion posterior to Cu_1 on the hind wing. Should these differences hold true in a larger series it may be advisable to separate this under another subspecific name.

The fresh series of males from Mill Creek shows a faint, small, pale discal patch on the fore wing above as noted above; this also occurs in some of the males from Ft. Simcoe, though more weakly. The Mill Creek series also averages somewhat larger than the others.

The specimens from Mt. Spokane are somewhat smaller, tend to be somewhat darker below and have the postmedian line of the fore wing below absent completely.

Several points concerning *sheridanii* in the Northwest merit further discussion. These points may be grouped under two broad headings: *geographic variation* and *climatic adaptation.*

Geographic variation. The differences between *sheridanii* populations from place to place are of a rather unusual nature. The most conspicuous aspect of this is the isolated occurrence of *s. neoperplexa* at Brewster, Washington, remote from the nearest other populations of that subspecies in southwestern Montana and with much of the intervening area occupied, apparently by *s. newcomeri* (see fig. 1). It is not yet known whether this Brewster *neoperplexa* represents an enclave entirely cut off from other *neoperplexa* populations or a peninsula-like intrusion, perhaps along river valleys.

The population of *newcomeri* at Lonerock, Oregon, differs more from any of the Washington populations than these do from each other, rather surprizing in view of its close geographic proximity. Lonerock and Ft. Simcoe, for example, are much closer than Ft. Simcoe is to Mt. Spokane; and both Lonerock and the Blue Mts. locality in Columbia Co., Washington, are on the same (northwest) slope of the same mountain range. In addition to its greater differentiation, the Lonerock series also seems less individually variable. Again it should be pointed out that the small size of the series makes these observations tentative and uncertain.

In Washington the known populations of *newcomeri* show a definite but rather low level of interpopulation differentiation as already discussed; and within each population a rather high level of individual variability. The interpopulational differences seem to bear little relation to the geographic distances separating the populations, the Mill Creek and Ft. Simcoe populations, for example, being only a little less different from one another than either is from the Mt. Spokane series.

There is evident here a definite hierarchy of differentiation: the greatest, that between *newcomeri* and *neoperplexa;* next, in *newcomeri,* between the Washington populations collectively and the one population from Oregon; and finally, the slight differentiation between the Washington populations. In a general way this hierarchy undoubtedly reflects the past history of the species in this region and it is a temptation to draw on it as well as on some of the other data on variation given above in speculation on the past events that may have led to the situation as it is today. Until larger series can be obtained, however, the data basic to such speculation would be far too shaky. My repeated emphasis of this point is in no way intended as a slight to the much appreciated efforts of Mr. Newcomer and Mr. Bauer: their collections are by no means small as series go in *Callophrys* and, further, they were not collecting with statistical needs in mind. Statistics is a notoriously avaricious taskmaster.

Climatic adaptation. The various factors which together make up what we call climate exert a strong control over the distribution of Lepidoptera as they do for many other groups of organisms. Indeed, we may imagine the range of a species of butterfly or moth as an area bounded by not one but a number of lines, each one representing a limiting value, for that species, of some particular climatic factor. Such a notion, evidently, is a great oversimplification but the principle is valid and useful.

We may touch on the problem only briefly and incompletely here in connection with *C. sheridanii.* Two types of climatic responses may be discerned: (1) responses to particular factors singly, and (2) responses to two or more jointly (correlated responses). The data used are weather bureau mean figures as recorded, for example, in *Climate and Man* (U.S.D.A. Yearbook of Agriculture, 1941). On no account is it to be imagined that the insects are necessarily responding directly to these variables as such. It is merely that they appear to function as indices more or less closely correlated with whatever factors may actually be responsible, factors which themselves may be quite inaccessible for analysis over a large area.

Three variables were selected for study: mean January temperature, mean July temperature, and mean annual precipitation. Values of these were tabulated for all the known *sheridanii* localities for which they were available, as given in Table 1. By inspection we may establish the approximate limits for each of these:

mean January: all records fall between 14° and 32°F

mean July: all records fall between 57° and 76° F

ann. precip.: all records fall between 10 and 25 inches

The map (fig. 1) shows the results of applying these limits over the northern part of the range of *sheridanii*: all the shaded areas lie outside them and hence are presumably unavailable to *sheridanii.*

Obviously these three factors are not sufficient to account for the whole of the present range of the species. A large part of Montana (east of the mountains) and of South Dakota, for example, fall within these limits, yet *sheridanii* does not occur there. It is quite probable that variables other than these three are, at least in part, responsible. Yet without extending observation beyond them the distributional limits of *sheridanii* could be approximated still more closely by the use of correlated responses.

TABLE 1

Mean temperature (° F) for July and January and mean annual precipatation (inches) for localities where Callophrys (Callophrys) sheridanii has been taken.

Station		Locality	mean Jan.	mean Jul.	mean ann. precip.
1	Wash.:	Ft. Simcoe	28.4	75.2	12.29
2		Blue Mts. (Columbia Co.)	28(ca.)	68(ca.)	?
3		Mt. Spokane, 5000 ft.	17.2	58.7	22(ca.)[1]
4		Brewster	27.6	73.8	10.66
5	Oregon:	Lonerock	31.7	62.0	15.44[2]
6	Mont.:	Dillon	24.4	65.1	16.67
7		Ennis	21.7	64.5	10.69
8		Polaris	20(ca.)	62(ca.)	?[3]
9	Wyo.:	Centennial	21.5	61.4	16.91
10	Colo.:	Boulder Co.	28(ca.)	71(ca.)	?[3]
11		Red Feather L., 8400 ft.	15.0	57.9	?[4]
12		Ft. Collins	26.0	68.9	15.20
13	Utah:	Stockton	25.5(ca.)	72.3(ca.)	12.90[5]
14	N. Mex.:	Cloudcroft	30.1	59.7	24.58[2]

1. Temperature values are those of Spokane reduced equally by a lapse rate of 1° F/300 ft. Precipatation estimated from regional values.

2. Spots for Lonerock, Oregon, and Cloudcroft, New Mexico, are omitted from the graph. They fall so far outside the pattern of the remaining localities that I strongly suspect them of not representing the particular localities where the sheridanii were actually taken. There is no error in the values themselves which were kindly confirmed for me by Mr. T. L. Long, National Weather Records Center, Asheville, North Carolina. Needless to say, this is a common problem in mountainous country where small differences in elevation or exposure can exert major changes in the climatic picture.

3. Estimated values.

4. Temperature values are those of Ft. Collins reduced as described in note 1.

5. All values are interpolated from those of two adjacent bracketing localities.

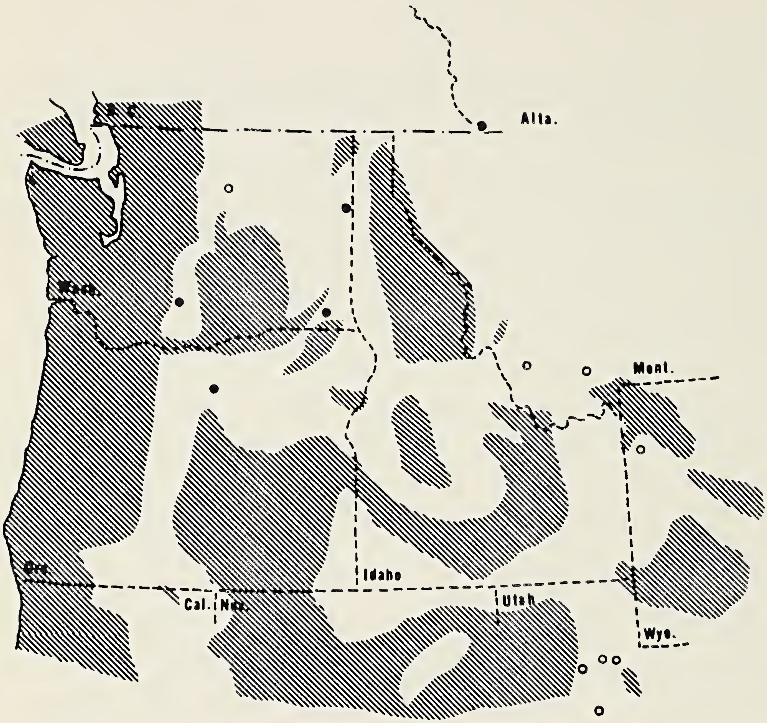

Fig. 1. Map of a portion of the range of *C.* (*Callophrys*) *sheridanii* showing localities of subspecies *neoperplexa* (open circles) and subspecies *newcomeri* (solid circles). Excluded areas (shaded) have one or more of the following: (1) mean January temperatures below 14°F or above 32°; (2) mean July temperatures below 57° or above 76°; (3) mean annual precipitation below 10 or above 25 inches.

The method of correlated responses makes use of a well known fact that organisms seldom respond to these or other climatic factors singly, but that tolerance to one is usually in some way related to the value of the other. This can be seen in the accompanying graph of *sheridanii* localities (fig. 2), plotted for values of mean January and mean July temperatures. When mean July temperature is below, for example, 60° F, then *sheridanii* will occur in such localities only if mean January temperature is somewhere between, roughly, 14° - 22°; but when mean July temperature exceeds 70° it occurs in localities where the mean January temperature is above about 24°. Thus for any given July temperature the range of tolerance to January temperatures is much less than the range applicable to the species over its whole range and conversely.

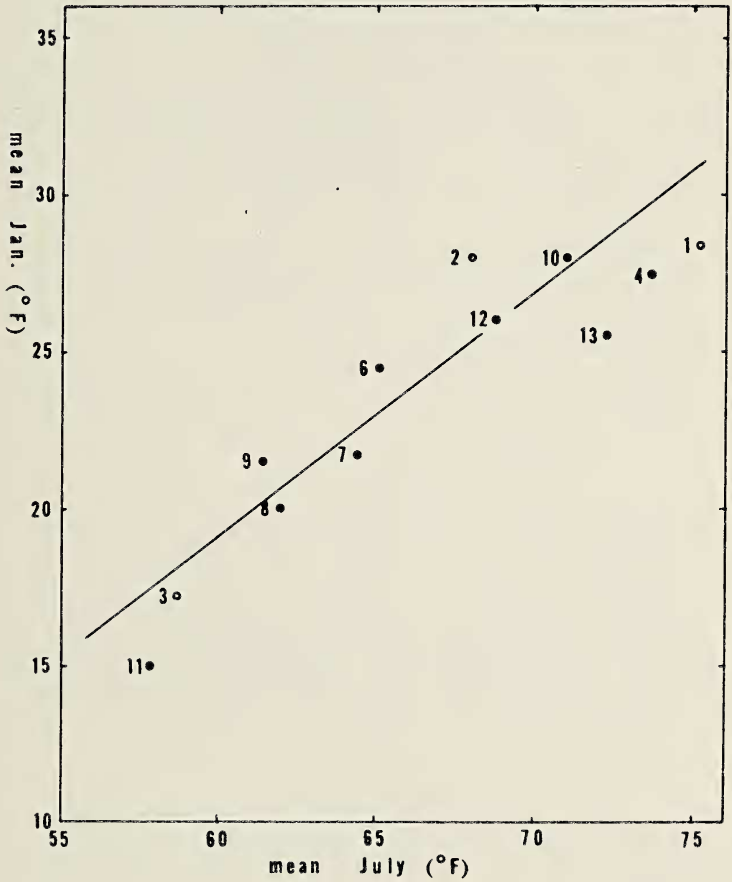

Fig. 2. Graph of known localities of C. (*Callophrys*) *sheridanii* (numbered as in table 1) according to their mean January and mean July temperatures.

Similar plots (mean January against mean July) have been constructed for several other Norther American lycaenids [*Callophrys* (*Incisalia*); *Lycaena thoe*], all of which show patterns generally similar to that of *sheridanii*. In all, for example, the correlation is rectilinear, occupying a band of more or less uniform breadth, though this breadth, the slope of the band, and its position vary from one species to another. In those species with a sufficient number of locality points (*sheridanii* is not one of them) a further, rather paradoxical, effect is noted: the upper limit of temperature tolerance is set by a January threshold, the lower limit by a July threshold. In other words, such species can extend into warm areas only to a point where increasing winter temperatures form a barrier; and can extend into cold areas only so far as summer temperatures continue to be sufficiently warm. Neither the heat of summer nor the cold of winter seems to be relevant. This may well be true of *sheridanii* but the available data are insufficient to demonstrate it.

There will be, then, within the limits set by the particular factors singly, additional "excluded areas" in this two dimensional manifold whose July and January means lie outside this band of correlated temperature responses. These, when added to the other excluded areas (as shown on the map, fig. 1), would still further restrict the territory available to the species. This has not been done for *sheridanii* because the number of locality points available is not sufficient to permit a reliable determination either of the central regression line or the breadth of the band. Inspection, however, shows that much of the above-mentioned areas of Montana and South Dakota would thereby be excluded. This, parenthetically, suggests that the correlated response to summer and winter mean temperatures is a major impediment to the eastward spread of *sheridanii*.

REFERENCES

BARNES, WILLIAM and FOSTER H. BENJAMIN, 1923. Notes and new species. *Contrib. Nat. Hist. Lejid. N. America*5 : 62-96 [*Callophrys*, pp. 64-69].

BLACKMORE, E. H. 1927. Check list of the Macrolepidoptera of British Columbia, *Victoria*: *E. H. Banfield*, 47 pp.

BOWMAN, KENNETH 1919. Annotated check-list of the Macrolepidoptera of Alberta. *Red Deer*: *Alberta Nat. Hist. Soc.*, 16 pp.

CLENCH, HARRY K. 1944. Notes on lycaenid butterflies. a. The genus Callophrys in North America. *Bull. Mus. Comp. Zool.* 94: 217-229.

———— 1961. Tribe Theclini *in* Paul R. and Anne H. Ehrlich, *How to know the butterflies* (Dubuque, Iowa: W. C. Brown Co.): 177-220 [*Callophrys* (*Callophrys*), p.p. 209-210].

LEIGHTON, BEN V. 1946. The butterflies of Washington. *Univ. Washington Publ. Biol.* 9: 47-63.